BUSINESS SENSITIVE

National Renewable Energy Laboratory FY00 Self-Assessment Report

Assessment Period:
October 1, 1999 – January 31, 2000

Contract No. DE-AC36-99GO10337

Operated for the U.S. Department of Energy by Midwest Research Institute • Battelle • Bechtel

Preface

The National Renewable Energy Laboratory (NREL) is managed and operated by the Midwest Research Institute (MRI), Battelle, and Bechtel under Contract Number DE-AC36-99GO10337.

The NREL Self-Assessment Report is submitted to DOE in accordance with the provisions of the prime contract. The report describes NREL's performance for the period of October 1, 1999 through January 31, 2000. Supporting information or additional documentation can be provided under separate cover to DOE for the Performance Evaluation Board.

Report Overview

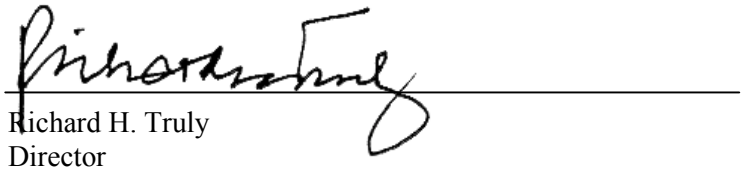
NREL has continued to evolve its performance measurement process and has streamlined the self-assessment report to more succinctly present the accomplishments of the Laboratory, and make it a more useful document to DOE as input to performance assessment as well as program and budget development and defense.

NREL began FY00 with a set of performance measures built around the six Critical Outcomes noted above. This report is structured around these Critical Outcomes, and focuses on the Performance Objectives associated with each. For each Critical Outcome, the accomplishments under each Performance Objective are listed, as are any related issues that NREL believes important to raise to the Performance Evaluation Board (PEB). Per our discussions and prime contract, NREL has also reviewed and assessed the effectiveness of all of its performance measures and presented a revised set for the remainder of FY00 under separate cover. This revised set of performance measures reflects DOE and NREL priorities as they have emerged over the first performance period.

Our intent is to provide the PEB with a short briefing as part of this self assessment. Together, the report and briefing will provide a thorough yet concise assessment of accomplishments, issues, and performance.

Approved for

NATIONAL RENEWABLE ENERGY LABORATORY



Richard H. Truly
Director

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Director's Summary

Performance Evaluation for the Period October 1, 1999 – January 31, 2000

Most of NREL's FY00 performance measures are annual in nature and scheduled for completion by September 30, 2000. This four-month self-assessment serves primarily as a "status report" of performance based on milestones met and progress to date toward meeting year-end objectives. Specific accomplishments for the Critical Outcomes are detailed in the body of this report, with a summary of major themes and accomplishments highlighted below.

Science, Technology and Deployment Facilitation

Conducting "world-class" science and demonstrating excellence in technology development and facilitation of deployment are NREL's primary objectives. We have reviewed all accomplishments associated with the key elements of this Critical Outcome during this four-month period:

- Measures of external visibility and recognition indicate NREL is well on track with its objective to increase recognition of the quality and significance of our technical work. These measures will be reported on an annual basis; year-to-date results show that NREL has already attained significant external recognition and visibility.
- All science, technology, and deployment facilitation program milestones due during this period were met on or ahead of schedule. NREL is conducting and managing programmatic work in a planned and systematic manner to meet and exceed customer expectations and strategic priorities.
- NREL has initiated several steps to meet DOE's expectations from the last performance period and is reporting important achievements in domestic and international activities for this point in the fiscal year. Considerable progress was made during this period in facilitating market conditioning and technology transfer, expanding stakeholder relationships and knowledge, and identifying market needs and drivers within and across programs. NREL is on course for meeting all current FY00 deployment facilitation goals.

Based on the progress made to date, we evaluate NREL's performance in this Critical Outcome to be "**Outstanding**".

Leadership

NREL and its managing partners provide leadership in the technical forums and peer communities in which the Laboratory operates and they provide the vision and leadership to further develop the Laboratory on behalf of DOE. NREL has set an aggressive agenda for gaining the support and visibility required for success.

- NREL's National Advisory Council continued to provide input that has helped to proactively guide the development and realization of the Laboratory's future through its initiatives.
- NREL has effectively partnered with DOE to build stakeholder relationships and formulate approaches for the Bioenergy, Natural Gas Industry, and Distributed and Hybrid Power initiatives. Collectively, this set of initiatives supports DOE priority initiatives and is tracking well.
- NREL's visibility and participation in technical, policy and other forums (national, international and local/regional) critical to DOE and NREL are increasing. The leadership activities and indicators are substantital for this first performance period.
- DOE has stated the leadership of MRI, as prime contractor, is essential to the long-term success of NREL and encouraged MRI to increase its visibility at NREL and to strengthen the tripartite corporate relationship. During this period, MRI and its managing partners have undertaken the following:

- *Increasing Communications with DOE GO*. Dr. Spigarelli, MRI's President and CEO, attended the last two NREL/DOE EE summit meetings; met with various groups in the Denver community; and undertook increased interactions with senior DOE GO and DOE EE personnel. MRI corporate staff communicated on a regular basis with DOE GO personnel.
- *Support for Initiatives To Have NREL Permanent Site Annexed by the City of Golden*. MRI's General Counsel is working with DOE GO to assure that any annexation of the NREL site will be accomplished without placing financial or other risks on NREL.
- *Conceptual Design for the NREL Research Support Facility (RSF)*. MRI's Vice President and Treasurer and its General Counsel are working with DOE GO on the conceptual design for the proposed RSF. MRI has offered several innovative ideas to DOE GO concerning the conceptual design review (CDR), and has proposed that MRI manage the CDR under the prime contract.
- *Rocky Flats Site.* MRI has been supportive of the DOE GO/NREL effort to acquire portions for the DOE Rocky Flats site for the performance of certain NREL program activities.
- *Award Fee Performance Incentives.* MRI's Vice President and Treasurer, and its General Counsel, are working with DOE GO and NREL to explore incentive mechanisms to be incorporated into the award fee evaluation under the prime contract.
- *Attracting Top Scientists to NREL.* MRI is working with NREL management to facilitate attracting and retaining top scientists and researchers to the Laboratory. In this regard, MRI facilitated the establishment of three Internet recruiting services to more rapidly identify employment candidates at reduced costs. In addition, MRI is prepared to provide appropriate employment incentives in critical cases.
- *Contractor Funded Technology Transfer (CFTT) Program*. MRI's General Counsel is working with NREL and its partners (Battelle and Bechtel) to develop a Contractor Funded Technology Transfer Program for submission to DOE. The guiding principle of the CFTT program will be to advance the mission and program interests of DOE and NREL.
- *Increasing Opportunities for NREL-Industry Interactions.* Battelle has assessed prior work that NREL has done for NASA to provide assistance in identifying emerging opportunities for NREL leveraging Battelle's relationship with NASA. Battelle provides support to NREL in developing the relationship with the natural gas industry, and will hold its semiannual Battelle Energy Advisory Council meeting at NREL in April in order to educate the members (all from the gas industry) about NREL. Bechtel is working to identify and solidify NREL's role in work-for-others (WFO) projects. Bechtel staff are working with the U.S. Agency for International Development to expand an existing work scope to include transportation-related studies and analysis with a prospective NREL role. Discussions also continued with a Bechtel development affiliate in Portland, Oregon to assess potential active NREL involvement in the facilities design for the Bechtel-led light rail transit project. MRI is working with NREL staff and industry to identify prospective cooperative research and development agreement (CRADA) participants and to generate industrial funding for NREL R&D CRADA efforts and WFO opportunities.
- *Strengthening Technical Networks.* Two NREL staff members are participating in Battelle technical networks which communicate technical knowledge and enable access to best available or unique capabilities on behalf of its DOE or commercial customers and Battelle is paying their travel expenses. This provides a low-cost opportunity to network broadly with Pacific Northwest National Laboratory, Brookhaven National Laboratory, and eventually Oak Ridge National Laboratory staff to explore areas for future collaboration.
- *Renewable Energy Initiatives.* MRI and its partners held an NREL Governing Board retreat to address various issues of concern to the corporate partners and NREL. Among the key issues addressed was developing a partnership/NREL strategy for aggressively pursuing NREL's involvement in various new Presidential, DOE and DOE EE renewable energy and energy conservation initiatives.

– *NREL's Licensing of Technology.* MRI's General Counsel is working with NREL management to identify approaches that can be used to enhance NREL's position in licensing technology under its Government Funded Technology Transfer Program.

Based on its accomplishments, NREL assesses its Leadership performance to be "**Low Outstanding**" for this Critical Outcome for the first performance period.

Laboratory Viability

Providing for the long-term viability (staff, facilities, equipment) of the Laboratory is a vital part of management's stewardship responsibilities.

- In response to DOE feedback regarding NREL's analysis capability, NREL submitted a proposed process to lead to closure on a shared DOE/NREL vision and strategy for a "world class" analytical capability during February. NREL, through teleconferences and meetings to understand DOE requirements, has prepared and communicated to DOE a proposed action mechanism.
- To meet DOE expectation that NREL's operational planning become better linked to the plans of DOE EE and timed to support budget preparations, NREL presented an overview of the Laboratory's critical infrastructure requirements at the January summit. Suggestions include those that sustain the value of DOE's investment at the NREL site, provide for cost-effectively meeting current mission requirements, and facilities and equipment for future, planned needs. This framework supports the FY01 request and the FY02 capital proposal. NREL also worked with DOE to identify process improvements to make the Field Budget Process more effective, such as elimination of the need to prepare field planning proposals.
- The Laboratory has developed research center hiring plans for strategic hires to fill critical skill and experience gaps. Ten such hires were identified and six were made in this first performance period.

Based on the progress made in this performance period, NREL assesses it performance to be "**Excellent"** for this Critical Outcome.

Mission Support

NREL's support functions are cost-effectively providing administrative and operations support services to efficiently carry out program and management activities. NREL has worked diligently to meet program, compliance and business requirements while capitalizing on opportunities for cost savings and productivity gains.

- Productivity enhancements implemented across each support function during this period have or will result in cost reductions and an improved ability to conduct work efficiently and effectively. Examples include greater use of electronic processes, tools and forms, completion of the migration from the "mainframe computer" environment and enhanced computational capabilities, the use of new information management systems such as IRS reporting, and significant reductions in patent filing fees.
- NREL has worked closely with DOE to define its cyber security requirements, and aggressively implemented a responsible cyber security program.
- Infrastructure projects (facilities and information technology) have been managed to cost and schedule such that NREL and its stakeholders will realize the intended benefits.
- NREL successfully transitioned the year 2000 because of its proactive investment and management of Y2K transition efforts. All compliance requirements were met or exceeded.

Based on the accomplishments and productivity results achieved in this performance period, NREL assesses its performance to be "**Low Outstanding**" for this Critical Outcome.

Environment, Safety and Health (ES&H)

The Laboratory's occupational safety and health and environmental protection program continued its strong performance during this performance period. Every ES&H performance measure shows that NREL is on track to meet or exceed external benchmarks and national norms.

- NREL gained Phase II validation of the Laboratory's Integrated Safety Management (ISM) System well ahead of schedule, and is on track to meet DOE's accelerated schedule for addressing identified issues.
- The NREL-wide chemical inventory was completed this performance period as a crucial part of implementing the new Chemical Management System.
- The Environmental Protection Agency Region 8 federal facilities coordinator identified the NREL ISM program as a "model" for use by other federal laboratories providing an external validation of the soundness of approach and effectiveness of the NREL Environmental Management program.
- Director Truly and ES&H Office Director McConnell initiated unannounced walk-throughs of NREL facilities to inspect and observe safety, occupational health and environmental conditions, and discuss issues with staff, as an enhancement to our self-assessment process. The schedule calls for a walk-through of one facility per month. Thus far, all of Building 16 and the FTLB have been completed.

Based on the accomplishments for this period, we have assessed NREL's performance for this critical Outcome to be "**Outstanding**".

Outreach and Communications

NREL's outreach, communications and education programs continue to increase the awareness of DOE and the Laboratory, and broaden impacts in local, regional and national stakeholder forums.

- Implementation of NREL's National Public Outreach Plan provided DOE programs with prime time television exposure on CNN, as well as coverage in significant publications such as the *New York Times* and *Washington Post***.**
- Several steps in establishing the Colorado Executive Outreach program were successfully completed, including the identification and invitation to the first nine VIPs to visit the Laboratory.
- NREL established several new educational relationships with universities and colleges, other national laboratories, and federal and state agencies.
- The first meeting on the NREL Education Advisory Council was conducted during this performance period where the role, charter, and activities agenda stemming from its strategic plan were established.
- NREL continued to excel as a corporate citizen. Its charitable giving program was greatly enhanced by the participation of all three managing partners and increased participation of NREL employees. NREL hosted the Community Leaders Forum and participated in many other local/regional events and programs.

Consistent with progress and accomplishments this performance period, we assess NREL's performance in this Critical Outcome to be "**High Excellent**".

Conclusion

Considering these significant accomplishments, we assess NREL's overall performance to be **"Low Outstanding"** for this initial FY00 four-month performance period.

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Critical Outcome 1.0 Science, Technology, and Deployment Facilitation

Conduct energy research, development, demonstration and facilitation of deployment activities leading to viable technology options that span energy pathways from supply through conversion and delivery to end use applications.

Performance Objective 1.1: *Produce high-quality, externally recognized scientific research and development results.*

Performance Indicators

1.1.1 Results of external reviews show that NREL's technical products are of high quality.

1.1.2 Recognition by the external scientific and technical community as measured by comparing NREL performance against benchmarks in a) external awards and recognition, b) peer reviewed publications, and c) number of patents awarded.

Significant Performance Indicator Accomplishments

External Reviews

- The General Accounting Office audited peer review procedures of both the Photovoltaics (PV) and Wind Energy Programs. Feedback from the reviews was that there is no lack of peer review and the process is well documented.
- During the National Academy of Public Administration review, the NREL Photovoltaics Program was verbally cited as a model.
- NREL's research for the DOE Office of Science/Chemical Sciences Program was peer-reviewed. As a result, one area received enhanced funding of $400K while other areas were maintained at the FY99 level.

External Recognition – External Awards and Recognition

- Tim Coutts received the John Thornton Memorial Award and lecture for contributions to the advancement of thin film photovoltaics technology.
- Art Nozik, Su-Huai Wei, and Alex Zunger were elected fellows of the American Physical Society.
- Michael Seibert was elected fellow of the American Association for the Advancement of Science.
- Maria Ghirardi, Tim Flynn, and Michael Seibert received the American Chemical Society Glenn Award for the best paper presented in the fuel chemistry division.
- Neil Kelley and Richard Osgood received the Best Paper Award at the 19th American Society of Mechanical Engineers, Wind Energy Symposium in January.
- Harin Ullal, Bolko von Roedern, and Ken Zweibel were cited among four finalists for the World Technology Network's Annual Energy Award.

External Recognition – Peer Reviewed Publications and Number of Patents Awarded

These will be reported at year end. We will compare NREL annual production with benchmarks derived from the Institute for Scientific Information. The benchmark data is available for other national laboratories, U.S. universities and research institutions.

Other Significant Accomplishments

External Recognition – External Awards and Recognition

- Ron Judkoff, Sheila Hayter, and Paul Torcellini authored the cover article on the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Technology Award in the December issue of the *ASHRAE Journal*.
- Richard Blaugher was appointed to the DOE Steering Committee for developing a "Cryogenic Roadmap for Superconducting Power Devices."

Issues

None

Performance Objective 1.2: *Demonstrate leadership in planning and managing programs to advance DOE objectives and present viable technology options.*

Performance Indicators

1.2.1 Customer feedback and review of performance against established programmatic AOPs demonstrate NREL's ability to impact customer's strategic objectives and advance viable technology options.

1.2.2 NREL's ability to effectively manage programs will be measured by performance against predetermined "key" sector milestones.

1.2.3 Year-end uncosted balances for the Laboratory are at or below the predetermined target levels.

1.2.4 The level of competitive procurements for the Laboratory meets or exceeds predetermined target levels.

Significant Performance Indicator Accomplishments

During the four-month performance period, eight key programmatic milestones were due. All of these were completed on time. One of the eight was completed earlier than scheduled and one milestone due in June was also completed during the period. All other milestones are on track to be completed as scheduled.

Office of Power Technologies (OPT)

Key Milestones

Description	Due dates	Status
Photovoltaics. Completed development of a small-system testing capability at the Outdoor Test Facility for performing standardized product evaluations of typical PV systems used in developing countries, and assess impact and performance of past project initiatives in developing countries.	Testing facility - January 2000 Input assessment - September 2000	Complete On track
Photovoltaics. Published the new DOE PV Program Five-Year Plan and facilitated completion of the U.S. Photovoltaics Industry PV Technology Roadmap.	Five-Year Plan - January 2000 Roadmap - August 2000	Complete On track
Geothermal. Prepared a report on analysis of the potential for small-scale geothermal power plants in the western U.S.	January 2000	Complete

OPT Strategic Goal #1: Triple Non-Hydroelectric Renewable Capacity by 2010

- *Proof-of-Concept Established Under High-Performance PV Initiative*. National Center for Photovoltaics (NCPV) researchers collaborated with ENTECH to produce a 28% mini-module using NREL's triple-junction solar cell in ENTECH's linear Fresnel-lens (10-suns) concentrator system. This is an important proof-of-concept demonstration for DOE's "third-of-the-sun" high-performance photovoltaics initiative.
- *Rapid Infrared-Based Spectroscopic Technique.* NCPV researchers developed a rapid, production-compatible Fourier-transform-infrared-based spectroscopic technique for screening single-crystal silicon wafers for AstroPower, Inc. This potentially high throughput diagnostic technique will be valuable in

qualifying starting material prior to solar cell processing, thereby improving production yields and lowering manufacturing costs.

- *Significant Progress Made in Solar Cell Materials and Devices*. The operation of the triple-junction GaInP/GaAs/Ge solar cell was extended to 1100-suns concentration. This proof-of-concept demonstration shows the viability for such high-efficiency, high-concentration devices. Researchers fabricated efficient all-hot-wire-deposited amorphous silicon solar cells at 18 A/sec, an order-of-magnitude higher rate than used in manufacturing today. Finally, the molybdenum substrate used in copper indium gallium diselenide (CIGS) devices was optimized to produce reproducible high-efficiency devices (many cells >18%, several at 18.5%). The previous process for the NREL record cell of 18.8% was difficult to reproduce because of substrate quality problems.
- *Unique Measurement of Thin-Film Devices Accomplished*. NCPV researchers successfully analyzed CdTe and CIGS thin-film devices in cross-section by atomic force microscopy for the first time. This is significant because it provides unique three-dimensional information with a spatial resolution in the nanometer range.
- *Deposition Rate Doubled.* BP Solarex, a subcontractor in the Thin Film Partnership, doubled the deposition rate while maintaining the efficiencies of their multijunction amorphous silicon modules. The higher throughput will result in lowering their manufacturing cost of modules, and may impact the likelihood of building their next, larger-scale manufacturing plant.
- *Automated Contact Machine in Full Production.* Evergreen Solar, Inc. integrated their automated contact machine into full production under their Photovoltaic Manufacturing Technology (PVMaT) subcontract. This implementation, in addition to other cell automation processes developed under this subcontract, are expected to result in a $0.59/watt reduction and contribute to a significant manufacturing capacity scale-up over the next several years by Evergreen.
- *PVMaT Effort Leads to Large PV Installation.* PCS 3300, a PV power conditioning system developed by Omnion Power Engineering Corporation under a PVMaT cost-shared effort, is part of a system installed at BJ's Wholesale Club in Conshohocken, PA. The 43-kW system is the largest solar generation facility in Pennsylvania and participants in this project recently won the coveted Partnership Award at the National Accounts Energy Management Awards ceremony held in Las Vegas, NV. The commercial buildings sector is a large potential market, and projects such as this are an early penetration into the market which demonstrates the usefulness of PV for these applications.
- *Key Collaborative Planning Document Published.* The NCPV published the DOE National Photovoltaics Program Plan 2000-2004, "Photovoltaics: Energy for the New Millennium." This is a key planning document, prepared in collaboration with stakeholders from industry and academia, and will be used to publicize the program's activities and goals to interested public and key decision makers within the U.S. government and the private sector.
- *Roadmap Proceedings Published.* The NCPV, working with PV industry and program stakeholders, facilitated the publication of the proceedings from the "U.S. PV Industry Technology Workshop". This summarized the results of the workshop held in June 1999 in Chicago, and met the target for producing this document before January 2000. The publication provides near-, mid-, and long-range barriers and objectives required to meet the targets and goals established in the framework roadmap.
- *Hydrogen-Passivation Awards Made.* Four universities were selected to receive awards under the "Hydrogen Passivation of Impurities and Defects in Silicon Solar Cells" solicitation. Developing new understanding of hydrogen passivation is a high priority for the PV industry to better control their processes for high-efficiency PV modules.
- *Preparations Made for Unsteady Aerodynamics Experiment.* Significant progress was made to prepare for the Unsteady Aerodynamics Experiment in the NASA Ames Wind Tunnel.
  - The turbine was installed in the 80 by 120 foot tunnel.
  - All data acquisition and reduction systems were verified.
  - System calibrations were completed. The test start date was delayed due to problems NASA is experiencing with the tunnel fan motors, but the June milestone is still on track.

- *Dynamometer Shake Down Tests Completed.* The National Wind Technology Center (NWTC) Dynamometer is fully operational.
  - Harmonic filters were repaired and are functioning.
  - The Zond Z-750 turbine is installed.
  - Gearbox tooth contact testing is completed.
  - Damage mechanism and load mitigation tests are underway.
  - An enhanced test program was requested to accelerate endurance tests of the current model.
  - Gear tooth pitting mitigation tests were added.
  - Testing is scheduled through August 2000.
- *Landmark Avian Research Guidance Established through Collaborative Process*. NREL, working with the Avian Subcommittee of the National Wind Coordinating Committee provided technical management and funding support to develop an avian research guidance document. The paper, *Studying Wind Energy/Bird Interactions: A Guidance Document*, was released by the National Wind Coordinating Committee. Although this document is not officially an NREL publication, NREL developed the strategy, managed the writing and review, and provided the funding support. The document was reviewed by a nationally recognized team including wildlife biologists, statisticians, industry members and environmentalists.
- *Small, Modular Biopower Procurements Moved to NREL.* The Phase II Small Modular Biopower procurements were successfully transferred from Sandia to NREL to centralize subcontracting, reduce subcontract costs, and address subcontractor preferences.
- *Vermont Gasifier Support Continues*. NREL engineering and analytical teams continued to provide on-site support during the assessment period. During late December and January, NREL engineers coordinated and helped implement tests to evaluate sand circulation rates and system response times and analyzed resulting data. This information is critical for defining the engineering fix to be implemented on the unit during the April-May timeframe and that will enable the long-duration testing needed for eventual commercialization.
- *Life-cycle Analysis Completed for Natural Gas Combined Cycle System (NGCC)* . NREL has added NGCC to its suite of life-cycle analyses. Since a large fraction of new generating capacity in the U.S. and abroad is NGCC, this is an important case to have for comparison purposes. The life-cycle assessments of biomass systems continue to be well received by the environmental and power production communities and are likely to be key to eventual acceptance of biomass generation as a "green" source of electricity.
- *Hydrogen Production Report Completed*. The report on life-cycle assessment for steam methane reforming was completed and is undergoing external peer review (comments are being collected and incorporated as appropriate). The report will be published as an NREL report on the DOE Hydrogen Information Network Web site.
- *New Record Set for Hydrogen Production*. A new record for hydrogen production by a bioreactor culture was achieved. The NREL Algal team reported that more than 400 milliliters of hydrogen gas were collected from one liter of culture using one cycle of the new two-stage hydrogen production system. This represents over a 50% increase in yield of hydrogen since the beginning of the summer, and a 100,000 times increase in productivity compared to what algal hydrogen investigators were recording 18 months ago.
- *Solar Thermal Hydrogen Production Demonstrated*. NREL demonstrated conclusive solar thermal production of hydrogen by thermal decomposition of methane. Hydrogen production from methane using highly concentrated sunlight was demonstrated in a collaborative project between the University of Colorado at Boulder, Chemical Engineering Department and NREL. The experiments were carried out at NREL's high-flux solar furnace using a unique reactor configuration. Initial measurements indicated very high conversion of methane to hydrogen. This process could prove to be an efficient and economic option for renewable production of hydrogen. In addition, the process could be used for conversion of other hydrocarbon sources for production of fuels (e.g., from contaminated gas wells) and carbon dioxide sequestration/mitigation.

- *Dish/Stirling Reliability Increased*. Improving the reliability of dish/Stirling systems is the critical-path activity to move the technology into commercial applications. This fiscal year NREL took over management of subcontracted efforts with Science Applications International Corporation (SAIC) to develop a 22 kW dish/Stirling system. The SAIC system was developed under a multi-year cost shared contract, but poor reliability raised the issue of whether the effort should be continued. Working with SAIC we have made three prototype systems operational, and have increased availability (one measure of the system reliability) from very low values to nearly the Phase 1 goal of 70%. These results bode well not only for the SAIC system but for reliability gains in other distributed power technologies based on concentrated solar power.
- *Report on Small-Scale Geothermal Power Completed.* NREL completed a report on the potential for small-scale geothermal power systems in the western United States. This report provides important information needed in the development of a solicitation for the design and construction of small-scale geothermal power plants to be issued by NREL by the end of February. This solicitation will form an important element of the Geopowering the West initiative.

OPT Strategic Goal #2: Implement Reliable and Accepted Standards for Integrating Distributed Power

- An industry forum was held to discuss proposed changes to 2002 National Electric Code and held an Institute for Electrical and Electronic Engineers (IEEE) working group meeting on small photovoltaic systems testing.
- *Overwhelming Response Received in Response to Distributed Power Letter of Intent*. In support of a key milestone to complete a competitive solicitation for distributed power systems integration research and development, NREL issued a Commerce Business Daily (CBD) announcement on November 8, 1999. Over 300 requests for the letter of intent were received from the distributed power community as of January 6, 2000 and these were mailed. The due date for proposals of January 10, 2000 was extended to January 24, 2000. More than 60 proposals were received.
- *Subcontract to Facilitate Standards Development*. A subcontract was awarded on November 2, 1999 with the IEEE to speed establishment of the draft standard P1547 IEEE Standard for Distributed Resources Interconnected with Electric Power Systems. This subcontract work encompasses Web site development and related services, and pre-publication secretariat support. The site was activated and inputs are currently being provided by the IEEE P1547 section leaders. Establishing this Web site is a key program milestone.

Office of Transportation Technologies

Key Milestones

Description	Due dates	Status
Alternative Fuels. Provide data spanning the range of sulfur concentrations that demonstrate effects of sulfur on performance of emission control technologies and had EPA cite the use of this data to support proposed rulemaking.	January 2000	Completed ahead of schedule.
Hybrid Vehicles. Complete development and validated specification for thermal comfort manikin including links to thermal comfort code and standards, and determined uncertainties required in thermal comfort measurements.	January 2000	Complete

OTT Goal #1: Develop and Work in Partnerships with the Domestic Transportation Industry, Energy Supply Industry, and Research and Development Organizations

- *Rapid Analysis Method Developed and Validated for Hardwood Feedstocks and Pretreatment Intermediates.* A Rapid Analysis was developed and demonstrated for the chemical characterization of biomass and biomass-derived products in the hardwood process. The speed (minutes vs. weeks), simplicity and low cost ($10 vs. $800 per sample) of chemical analysis using validated Rapid Analysis techniques offers many advantages over the conventional wet chemical methods currently used. In addition, the precision and accuracy of Rapid Analysis methods matches that of the conventional wet chemical techniques used for the method calibration.
- *Four Feasibility Studies Completed.* Four feasibility studies for the incorporation of a cellulosic bioethanol production into an existing corn-ethanol facility were completed. These studies were conducted by teams of engineering companies and operating companies under subcontract to NREL.
- *Readiness Verification of Countercurrent Extractor Completed.* Installation and readiness verification of a pilot-scale countercurrent extractor was successfully completed. This extractor will be used to generate preliminary design data necessary for obtaining reliable estimate of capital and operating costs of recovering sugars from hydrolysates in a number of bioethanol process technologies, including two-stage dilute acid hydrolysis, separate enzymatic hydrolysis and fermentation, and simultaneous saccharification and fermentation with hydrolysate conditioning). The data will improve the robustness of process simulation models for these technologies.
- *Initial Evaluation of Hot Separation and Washing Test Unit Conducted.* Initial evaluation of a test unit for performing the hot separation and washing function in the improved prehydrolysis process has been conducted. This unit provides test data that can be utilized in scale-up calculations to a pressurizeable continuous belt filter manufactured by Pneumapress Inc. (Richmond, CA). This unit was plumbed directly to a modified 1 liter Parr reactor that allowed for direct transfer of the high temperature pretreated slurry to the filtration test unit. Observational analysis of the liquor and solids indicated that these process streams have the physical characteristics of continuously flowing hydrolyzates and should result in highly pretreated solids.
- *Biofuels Partnerships Fermentation Tests Completed.* Five pilot-scale (150 liter) fermentation runs were completed with consistent high yields for our cooperative research and development agreement (CRADA) partner Arkenol Holdings LLC of Mission Viejo, California. The runs were designed to show stability of the organism and consistency of fermentation performance and were required by Arkenol in order to obtain engineering guarantees for their planned facility in Sacramento. The CRADA is now focusing on the development of superior fermentation strains. We are currently testing methods to integrate xylose-fermenting genes into the host genome. Two methods were identified and are currently being tested.
- *Corn Refiner's Association/National Corn Growers (CRA/NCGA) CRADA*. The two-year funds-in CRADA on "Development of Superior Microorganism (Zymomonas) for Fermentation of Sugars from Corn Fiber to Ethanol" was completed. Individual members of the Corn Refiner's Association can now obtain the strain for development or commercial use in their facilities. Their initial interest is in the conversion of corn fiber to ethanol. Some members of the CRA are independently evaluating the recombinant *Zymomonas mobilis* strains developed during this CRADA.
- *Progress Made in Developing Yeast Strains.* In a second CRADA with the CRA/NCGA, "Development of Yeast Strains for the Efficient Fermentation of Arabinose from Corn Fiber," NREL made excellent progress on the construction of an arabinose fermenting yeast. NREL has cloned several important genes into the yeast organism selected for the work.

OTT Goal #2: Develop Advanced Transportation Vehicles and Alternative Fuel Vehicles which will Reduce Oil Import Requirements, Reduce Criteria Pollutant Emissions and Greenhouse Gases

- *Thermal Comfort Manikin Specification Developed.* NREL conducted a worldwide benchmarking activity and subsequently developed specifications for a high technology thermal comfort manikin to be operated

under computer control modeled to represent human thermal regulatory behavior including sweating. It is expected that this manikin, when built and validated, will be adopted by SAE and used for the standard in determining human comfort in vehicles. Currently NREL is developing the manikin in support of reducing the auxiliary loads on vehicles which cause 0.5 mpg decrease for every 100 watts used in the PNGV-like vehicles.

- *Prototype Automobile Air Cleaning Unit Developed.* NREL obtained a record of invention for a prototype automobile cabin air cleaner that can remove volatile organics, bacteria, and viruses from the air. It also has multiple applications to indoor air quality in other environments. This work leveraged other research activities that NREL is conducting for the Center for Indoor Air Quality and for NASA.

OTT Goal #3: Promote the Commercialization, User Acceptance, and Achievement of the Vision of Advanced Transportation Technologies and Alternative Fuels

- *Data on Sulfur Concentrations Developed and Used in Proposed Rulemaking.* NREL provided data spanning the range of sulfur concentrations of sulfur in diesel fuel that demonstrate the effects of sulfur on the performance of emission control technologies for motor vehicles, and EPA is using these data to support proposed rulemaking on the composition of diesel fuel. These data were developed by a government-industry working group, and they are considered to be the most comprehensive, objective data available.

Office of Building Technologies, State and Community Systems

Key Milestones

Description	Due dates	Status
Buildings. Assisted three major residential developments to design and build new climate-appropriate combinations of high-performance envelope and equipment systems and report on results of performance tests.	December 1999	Complete
Buildings. Analyzed, tested, and reported performance of advanced desiccant dehumidifiers supplied by industry partners and identified design/material options that provide the best performance benefits relative to conventional systems	December 1999	Complete
Buildings. Conducted accelerated durability testing of electrochromic window prototypes and performed fundamental research to identify and report on root causes for primary degradation mechanisms that limit service lifetimes	December 1999	Complete

BTS Strategy #1: Accelerate the Introduction of Highly Efficient Technologies through Research and Development.

- *Durability of Electrochromic Windows Improved.* NREL initiated a new round of durability testing of large-scale electrochromic window samples with Eclipse, Donnelly, and Sage. Donnelly and Sage have made significant progress in scaling up their manufacturing processes and improving durability based on initial test results. Tests will continue for the remainder of the year to compare large-scale device performance.

- *Enthalpy/Heat Recovery Wheel Performance Tests Completed*. NREL completed tests comparing the heat and mass transfer performance characteristics of enthalpy wheels, air-to-air heat exchangers, and a membrane heat exchanger. The test results are being used by the Air-conditioning and Refrigeration Institute to evaluate their proposed rating procedure. The test results will also be used by the American Gas Cooling Center to provide average performance information to equipment designers and contractors.
- *Technology and Process Roadmapping Workshops for Commercial Buildings Completed.* NREL is providing technical support for the Commercial Building Roadmapping activity that focuses on building cooling, heating and power. Technology and process workshops were completed. The final workshop on policy issues is scheduled for March 21.
- *Building American System Performance Tests Completed.* System performance tests were completed in Michigan (Pulte Homes) and Texas (Medallion Homes). The tests measured reductions in space conditioning energy use that are produced by Building America system designs in hot and cold climates. Test results will be used to improve system designs and evaluate opportunities for cost tradeoffs that can be used to increase house performance without increasing house cost.

BTS Strategy #2: Increase the Minimum Efficiency of Buildings and Equipment through Codes, Standards, and Guidelines.

- *Energy-10 Design Tool Version 1.3 Released*. NREL released version 1.3 of the Energy-10 design tool in collaboration with Lawrence Berkeley National Laboratory and the Sustainable Buildings Industry Council. Version 1.3 includes the ability to automatically downsize equipment capacity as design improvements reduce energy use and automates the production of weather data files for all U.S. cities. Work was initiated linking Energy-10 to the Energy Plus Building Energy Simulation Engine.

BTS Strategy #3: Encourage the Use of Energy Efficiency and Renewable Energy Technologies and Practice through Technology Transfer and Financial Assistance.

- *Building America Case Studies Competed.* NREL completed development of a Building America folder and project summary sheets for Village Green and Mitchell Homes. Work was initiated to update case study and project location information on the Building America Web site.
- *State Special Project Grants SOW Supported*. NREL supported the DOE Golden Field Office (DOE GO) in the development of the technical statement of work (SOW) to add State Energy Offices as Building America Partners. The grants will be awarded on a competitive basis and will expand the contributions of State Energy Offices to the Building America Program.

Federal Energy Management Program (FEMP)

FEMP Goal # 1: Reach 1500 federal customers and industry partners through workshops, presentations, working groups, industry forums, and conferences.

- *Reaching Federal Customers.* NREL FEMP reached 433 federal customers and industry partners through three workshops, four working group presentations, seven industry forums and customer meetings, and two conference presentations.

FEMP Goal # 2: Support federal customers with 40 DOE EE and water projects through FEMP's Technical Assistance and Project Financing Services and solicit customer feedback to evaluate level of satisfaction.

- *Supporting Federal Customers.* NREL has already achieved its goal for this metric for the entire year by supporting 59 projects to date. Several projects have been awarded totaling a cumulative cost savings of over $25 million and a private sector investor of $13.3 million.

- *Wind Source.* NREL assisted the Environmental Protection Agency (EPA) leading to EPA signing a Green Power contract with the Public Service Company of Colorado for 32,000 kWh of WindSource power each month (approximately 15% of total building load) in November 1999.

FEMP Goal #3: Support FEMP outreach through 90,000 visits to the FEMP Web site and production of ten new publications.

- *Supporting Outreach via Web Site.* NREL accumulated 57,952 visits to the FEMP Web site in October through December (January numbers not available). Five publications were completed with an additional 11 in process.
- *Save with Solar.* The *Save with Solar* newsletter won a third place award from the Society for Technical Communications.

Office of Industrial Technologies (OIT)

Key Milestones

Description	Due dates	Status
Industries of the Future - Forest Products. Completed Near Infrared Spectroscopy methodology field demonstration at a pulp and paper company.	July 2000	Completed ahead of schedule.

Support in Implementing Industries of the Future Roadmaps

- *A mill run test of near infrared on-line calibration methodology successfully completed by NREL ahead of schedule*. The test was conducted at a Champion International mill in Florida. Researchers exceeded objectives in several respects. They obtained ten hours of continuous monitoring on moving chips (2.5 times the amount planned), they were able to test a new on-line continuous performance surveillance scheme (not previously disclosed), both hardwoods and softwoods were tested without instrument failures. This amount of testing translates into 1200 spectra and 88 MB of data, which corresponds to measuring 51 miles of chips on the conveyor or 1350 tons. If these chips were analyzed in the laboratory sequentially, the cost would have been $1.2M and it would have taken months to get science-based composition results. The analytical methodology of near infrared was successfully demonstrated and could lead to new process control capabilities for the Forest Products industry. NREL's calibration expertise and information gathered through the Agenda 2020 Sensors and Controls project will allow forest products companies to successfully deploy this methodology in their plants for a variety of applications.
- *A new draft of "Doing Business with the DOE Laboratories" was completed by NREL*. This report of the Laboratory Coordinating Council was submitted for OIT review and distribution to industry and OIT stakeholders for comments. The report contains information that has not been assembled before in this manner explaining the various laboratories, their management, their field office structure, key capabilities, contractual mechanisms for industry to work with the laboratories, and provisions of intellectual property rights and data protection.
- *Technical Expertise Provided Under Eastman Chemicals-NREL CRADA.* Technical expertise was provided by NREL staff in meetings Eastman is having with potential business partners. NREL staff presented outstanding results that are being obtained in the clean fractionation technology making cellulosic materials for Eastman with NREL's technology.

Office of Science (DOE SC)

Materials Sciences Program Objective: Increase the understanding of phenomena and properties important to material behavior that will contribute to meeting the needs of present and future energy technologies.

- *Order-disorder Effect.* Order-disorder is first a statistical effect. However, in the past ten years our studies of spontaneous ordering in III-V alloys have focused on ordering induced changes in crystal structures, electronic and optical properties on a macroscale. Recently we have successfully investigated the statistical effort of ordering in a microscopic scale because of improved materials quality (*Phys. Rev. B*, in press, Y. Zhang et al).
- *Lateral Composition Modulation.* A recent breakthrough was made at NREL in achieving a high structural uniformity of the lateral composition modulation in AlInAs alloys (the length scale of the uniform structure far exceeds the quantum scale up to a micron). (1999 MRS invited talk)
- *Alloys of GaAsN and GaPN.* Dilute nitride alloys of GaAsN and GaPN are new materials with many potential device applications, and have been intensively studied in recent years. We recently proposed that the mechanism for the band-gap reduction is the formation of a nitrogen induced impurity band, and the consequence of such a banding effect on the electron effective mass has been demonstrated experimentally. (*Phys. Rev. B*, in press)
- *Doping Bottlenecks in Semiconductors.* Extensive first-principles calculation is being carried out to understand the origin of doping bottlenecks in semiconductors and comparing the results with experiments. A paper has been published recently in *Physical Review Letters* 84, S. Zhang, S. Wei, and A. Zunger, 1232 (2000) on this subject.
- *Carbon Nanotube Membranes.* 1) NREL is growing ordered arrays of c-nanotubes by CVD process using electrochemically-grown porous aluminum templates. This composite membrane is used to test selective permeation of H_2, CH_4, and CO_2. We are currently optimizing the process to enhance selectivity. The results obtained thus far are being published in the journal, *Chemistry of Materials*. 2) NREL has taken an important step towards realizing the fabrication of a membrane by developing methods, which unravel, cut, and align the as-produced SWNT tangle. These individual superbundles may act as building blocks for larger structures. The methods for forming the superbundles have been accepted for publication and will appear soon in Chemistry of Materials. T. Gennett, A. C. Dillon, J. L. Alleman, K. M. Jones, F. S. Hasoon, and M. J. Heben; Formation of Single-Wall Carbon Nanotube Superbundles, Chemistry of Materials; 2000.
- *Pulsed Laser Deposition Growth Space*. Considerable progress has been made on developing the pulsed laser deposition growth space for V_2O_5. We have examined the effects of substrate, temperature, and oxygen partial pressure. This is the most complete study of this kind to date.
- *Li Battery Electrodes.* The PITT technique for determining diffusion constants for Li battery electrodes have been modeled by NREL. These efforts represent one of the most complete assessments of this approach taking into account the model assumption, inhomogeneous Li distribution and the presence of offset currents. Developing a complete understanding of how to determine this critical parameter is critical to the ability to test and evaluate cells.

Chemical Sciences Program Objective: Provide the knowledge required to develop energy technologies that meet national goals of energy efficiency, public health and safety, environmental protection and restoration, and conservation of natural resources.

- *Molecular Semiconductors.* Successful "correct" doping of molecular semiconductors has been achieved for the first time, increasing the conductivity by a factor of one million.
- *Anti-Stokes Photoluminescence.* Experiments using optically-detected magnetic resonance (ODMR) have yielded initial results that help explain the mechanism of anti-Stokes photoluminescence (up-conversion) in quantum dots. The important role of electron trapping by surface states has been confirmed.

- *Quantum Dots.* Initial experiments wherein InP quantum dot arrays are formed from dots that are not capped with organic stabilizers (like trioctylphosphine oxide) show measurable conductivity for the first time.
  Quantum dots composed of an InP core and a lattice-matched CdZnSe shell have been successfully prepared for the first time. These quantum dots are good candidates for forming improved quantum dot arrays.
- *Rapid-throughput Methods Applied to CO_2 Reduction Catalysts.* Preliminary studies indicate the feasibility of using rapid-throughput methods for studying bimetallic electrocatalysts for CO_2 reduction. Five bis(triphophine) capable of bridging two transition metals have been prepared. These ligands will be used to systematically explore bimetallic complexes as catalysts for CO_2 reduction.

Energy Biosciences Program Objective: Obtain the fundamental knowledge necessary to develop future energy-related biotechnologies.

- *Research in Carbon Management.* The objective of our program on Fundamental Research in Carbon Management is to identify elements involved in regulating the partitioning of photosynthetic reductants between the H_2 evolving and the CO_2 fixation pathways in the alga C. reinhardtii. One of our proposed approaches is to chemochromically screen a library of insertional mutants for the ones that are unable to evolve hydrogen, due to interruption of a regulatory gene. We have screened about two-thirds of the library and identified more than 30 mutants so far, two of which were characterized in more detail. Both mutants were photosynthetically competent but exhibited very low rates of hydrogen evolution compared to the wild type. This could be due to the presence of an insert that interrupts either the hydrogenase gene itself or another gene encoding for a regulatory protein. Additional studies are underway to clarify the situation

Goods and Services on Order (GSO)

- NREL will manage GSO balances per the methodology established and approved by DOE GO last year. Per that approach, it is meaningless to comment on "progress/status to date," however, NREL continues to monitor and responsibly manage GSO balances to meet its targets.

Subcontracts

- NREL exceeded internal goals for competitive subcontracts for this point in the fiscal year and is on track to meet established baseline performance targets for the end of this fiscal year. Current statistics show that of 412 subcontracts placed during the first performance period, 303 (74%) are competitive and 109 (26%) are not. In terms of dollars NREL was awarded $22.4 million (77%) competitively, and $6.5 million (23%) non-competitively. In addition, NREL placed 20% more subcontracts (in dollars) in the first quarter of FY00 then it did in the same period of FY99 which contributes to proactive GSO management.

Issues

- Reduced travel targets, particularly in the Energy and Water programs, are placing significant constraints on our programs. While we will manage to these targets and meet program milestones, our ability to engage in meaningful interactions with DOE program managers, external stakeholders, and outside collaborators and subcontractors is significantly diminished. Any increases in program scope or new activities will require negotiating a higher target.

Performance Objective 1.3: Implement an integrated market-based approach to facilitating deployment of NREL technologies.

Performance Indicators

1.3.1 Customer feedback indicates that NREL programs and initiatives are responsive to market conditions and directions.

1.3.2 NREL's ability to effectively implement stakeholder relationships will be measured by performance against predetermined deployment objectives.

1.3.3 The composite measure for technology transfer activities meets or exceeds established goals.

Significant Performance Indicator Accomplishments

Facilitate Market Conditioning and Technology Transfer

- Filed 24 records of invention and 11 U.S. patents; executed one license; signed three work-for-others (WFO) agreements, one analytical services agreement and two CRADAs (combined CRADA value of $4.2 million).
- Established "Incubator Alliance" working groups in Texas and California; used Seattle "Industry Growth Forum" to educate incubator personnel and introduce them to investors.
- Supported DOE in completing negotiation of a model WFO agreement with the California Energy Commission.
- NREL leads the Technology Cooperation Agreement Pilot Project (TCAPP) for DOE, Agency for International Development (AID), Environmental Protection Agency (EPA), and the State Department. During this period NREL:
  - Assisted Brazil, China, Kazakhstan, Korea, Mexico, and the Philippines with design and initiation of a broad range of specific DOE EE investment actions in concert with U.S. businesses. For instance, the Philippines DOE approved a series of policy reforms to expand markets for renewable energy technologies.
  - Convened events and meetings at COP-5 to enable the participating countries to share their work with the international climate change community and to have discussions with senior U.S. governments on market-based approaches for implementation of technology transfer under the United Nations Framework Convention in Climate Change (UNFCCC).
  - Assisted the governments of China, Korea, and the Philippines in preparing papers and presentations for the UNFCCC regional workshop on technology transfer based on work in these countries and prepared a draft paper on technology transfer for the business community.
- Supported other DOE, EPA, and AID climate change programs, including analysis of the air pollution benefits of climate change energy measures, development of DOE EE joint implementation and clean development mechanism projects, and preparation of these measures for developing country climate change action plans:
  - Convened event at COP-5 to present results from work for Argentina, Chile, and Korea on air pollution health benefits of clean energy projects.
  - Chile completed preliminary assessment of air pollution health benefits of their energy measures that are under consideration for greenhouse gas mitigation, showing the monetary value of these avoided health damages is nearly equivalent to the costs of these measures.
  - Initiated exploratory discussions with Brazil, Mexico, Egypt, India and several southern African countries on the development of joint implementation and model clean development mechanism projects and are developing proposals for foundation support for the work in Brazil and Mexico.
  - Initiated technical support to Mexico to help them refine the energy measures in their climate change action plan.

- Leading the development of a project to create a World Renewable Energy Resources Atlas. During this period the United Nations Environment Programme/Global Environment Facility approved a project development grant to develop the detailed project proposal and implementation plan.
- Initiated a proposal to deploy compressed natural gas vehicles in Russia.
- Established Technology Partnership Ombuds Program in response to the DOE Secretary's initiative.

Identify Market Needs and Drivers

- Two Wind Powering America stakeholder strategic planning meetings were held; electric transmission constraints were identified as a significant barrier to achieving program goals.
- Facilitated a scenario-planning workshop with the Hydrogen Technical Advisory Panel and Hydrogen Fuel Infrastructure Development. Blueprint draft was reviewed by steering committee and posted on DOE Hydrogen Information Network for public comment, leading to a better understanding of infrastructure barriers, needs and requirements.
- Participated in bioenergy technology roadmapping efforts.
- Collected utility rate data and conducted analysis for specific geothermal plant sites in U.S. to support the GeoPowering the West initiative.
- DOE EE technology analysis of airport terminal facilities initiated to identify the potential for an initiative in this area.

Incorporate Market Needs and Drivers in Developments

- NREL is supporting Global Solar in developing a unique approach to high efficiency copper indium diselenide photovoltaic roof shingles that will lead to greater marketability.
- NREL implemented a small system test facility that will test a variety of small PV and wind systems typical of those used in developing countries. The data will be made available to U.S. industry allowing improvements to be made in their products and to judge the performance of their competitor's products in the international arena.
- Collected data from systems installed in Chile to enhance future design and operation.
- Collected data and performed analysis for performance evaluation and design feedback from 12 wind-diesel systems installed for use by end users in FY99 in Russia.

Inform Stakeholders

- Published 200 new publications. Examples include: a business development study, *Renewable Energy Markets in China: An Analysis of Renewable Energy Markets in Guangdong, Jiangzi, Jilin and Yunnan, with Updated information from Beijing;* and, *PV Business Application and Evaluation*, containing interviews with a large number of PV cell and module manufacturers, distributors, and integrators.
- Developed new material for State Energy Alternatives Web site, including three new technologies, an overview of state restructuring decisions regarding renewable energy, and further explanation of state policy options related to renewables.
- Provided detailed technical information and policy analysis to assist the Western Regional Air Partnership with the development of policy recommendations for meeting regional renewable goals to resolve state air quality issues for 10 states. Educated Colorado energy and environmental officials on the potential benefits of DOE EE technologies in meeting state goals, including improvement of air quality and Smart Growth.
- Conducted a U.S./China Renewable Energy Business Workshop with DOE and 13 U.S. companies in China. The workshop and study tour assisted U.S. companies with potential new customers, distributorships, and partnerships.
- Educated state and local decision-makers regarding the impact of their policy considerations on the potential deployment of renewable energy and energy efficiency technologies through collaboration with the Electric Power Research Institute hybrid vehicle working group.

- Presented information on renewable energy technologies and policy options for states to 75 state legislators at a National Conference of State Legislatures workshop.
- Developed Web site, conducted outreach to business partners, and developed plan for products and services under the Energy Smart Schools Initiative.
- Completed a Web site that provides information on the U.S./China Bilateral Protocol on the Utilization of Energy Efficiency and Renewable Energy Technologies, as well as business and policy information, for companies that are interested in the Chinese markets. This will be linked to a Chinese language Web site (www.nrel.gov/international/china).
- Participated in GreenE meetings to improve public perception of biopower and develop a more coherent environmental story.
- Supported DOE in the African Ministerial with a booth and a Renewable Energy for Rural Electrification tutorial.
- Discussions conducted with various Bechtel client groups on DOE EE technology opportunities.

Issues

- NREL recommends that DOE EE designate a focal point for domestic deployment programs and initiatives, similar to the successful focal point for international programs, to enhance joint NREL/DOE EE deployment effectiveness. This approach has been discussed with and is being championed by DOE GO. It was also discussed at the October 15, 1999 DOE/NREL Senior Management Meeting.
- NREL encourages DOE EE to accelerate the process of committing FY00 funds for international activities. DOE has $1 million in non-earmarked funds to be distributed. NREL FY00 activities for DOE EE are limited to those funded under the FY00 Omnibus appropriation that arrived late in FY99.

Critical Outcome 2.0 Leadership

Provide the leadership to promote NREL's national and international standing, ensure intellectual excellence and foster responsible stewardship of the DOE resource.

Performance Objective 2.1: *Demonstrate leadership in advancing initiatives that support the DOE-EE mission.*

Performance Indicators

2.1.1 NREL will broaden stakeholder understanding and support for the distributed power strategy.

2.1.2 Feedback from bioenergy stakeholders indicates the value of a DOE National Bioenergy Center.

2.1.3 Relationships have been established with the natural gas industry and opportunities for collaboration have been identified.

2.1.4 New proposals have been submitted to the Office of Science in areas that advance EE program objectives.

Significant Performance Indicator Accomplishments

Collaboration with Natural Gas Industry

- NREL's leadership in this arena has resulted in establishing a solid working relationship between all facets of both the natural gas and renewable energy industries, establishment of a common research agenda, and an agreement to bring the leaders of these two industries together to close on priorities.
  - November 22, 1999. The natural gas trade associations represented were the American Gas Association, Interstate Natural Gas Association of America, and the Natural Gas Supply Association. The presidents of the three organizations attended, as did the president of the Business Council for Sustainable Energy (BCSE). Dan Reicher and Richard Truly chaired the meeting. The three trade groups were in favor of creating an alliance of some type, and developed a short list of both short- and long-term agenda items they are interested in working on with the renewable energy industry.
  - December 15, 1999. The renewable energy trade associations represented were the American Bioenergy Association, American Wind Energy Association, Geothermal Energy Association, Hearth Products Association, National Bioenergy Industries Association, National Hydrogen Association, and the Solar Energy Industries Association. BCSE was also represented. Dan Reicher and Richard Truly chaired the meeting. While there was skepticism expressed, agreement was reached that there would be value in working with the gas industry. The trade groups developed a list of both short- and long-term items of interest to them.
  - During there discussions the label of "alliance" was changed to a title of "Natural Gas and Renewable Energy Roundtable." NREL has also developed an integrated set of items expected to form the basis of a common agenda between the two groups. The next step will be a meeting scheduled in March with attendance by representatives from both groups. The attendance will be broadened to include industry CEOs.
- NREL has begun the process of building a collaborative relationship with DOE's newest national laboratory, the National Energy Technology Laboratory (NETL), and understanding their role in this initiative.
- Produced final report on the role of hydrogen in the natural gas industry for the International Gas Union's tri-annual meeting.

National Bioenergy Center

- Feedback from stakeholders in the commercial sector and from the NREL National Advisory Council was solicited and continues to support the soundness of NREL/ORNL proposed National Bioenergy Center in supporting the DOE initiative and the Executive Order.
- NREL led the effort to clarify actions needed to move forward on designation of a National Bioenergy Center. Three actions were identified and they have been completed this performance period:
  - A draft action memorandum from Dan Reicher to Secretary Richardson.

- Rollout options for an announcement of the national center.
- A draft list of who is to be notified prior to the announcement.

These items are being worked with the director of the Bioenergy Coordination Office and vice-chair of the DOE Bioenergy Working Group. NREL, along with Oak Ridge National Laboratory (ORNL) is prepared to support such a secretarial announcement.

Distributed and Hybrid Generation

- NREL was represented at the initial meeting of the Consumer Energy Council of America (CECA) Distributed Energy and Domestic Policy forum. CECA forums strive to build consensus and frame policy issues around critical issues like distributed energy. The chairman and vice chairs are, respectively, the Hon. Charles Curtis, chairman of Distributed Energy Forum, executive vice president, the UN Foundation, and the Hon. Ernest Moniz, vice chairman of Distributed Energy Forum, undersecretary, U.S. Department of Energy. The purpose of the first meeting was to: 1) introduce the participants and identify priorities; 2) discuss each of the issues and challenges presented in a background white paper drafted by CECA; 3) formulate questions that need to answered during the forum; 4) add any additional issues and challenges to be addressed; 5) define what the forum means by distributed energy; and 6) discuss organizational structure of the forum, including the proposed subcommittee structure, and schedule of events. The group decided to form three main subcommittees: Consumer Welfare Impacts of Distributed Generation, Technology Assessment and R&D Needs, and Regulatory and Public Policy Paths Forward.
- An NREL "Point of View" on distributed and hybrid generation was presented at Energy Innovations 99, California Energy Commission Public Interest Energy Research (PIER) Program, San Diego, CA, October 1999. As input to the CEC PIER planning activities, the presentation covered:
  - A market analysis of renewables, electricity and natural gas.
  - The vision for distributed and hybrid generation as a market strategy for renewables.
  - Descriptions of the niche markets and "full-value" markets destinations for distributed power industry.
  - Identification of barriers to distributed power deployment and high level strategy for barrier removal.

DOE EE and Office of Science (DOE SC) Collaboration

- NREL continued to interact with DOE SC to identify and develop opportunities for collaboration. As examples, Arthur Nozik and David Ginley served as members of the DOE SC panel to identify research opportunities in nanostructures.

Issues

- Clarification with respect to DOE EE's strategic intent with respect to NETL is needed.

Performance Objective 2.2: *Demonstrate leadership nationally and internationally that enhances NREL's visibility.*

Performance Indicator

2.2.1 NREL's participation in panels, committees, and other forums has national or international significance.

Nationally- Focused Leadership and Professional Activities

- Richard Truly served as chair of the Defense Science Board Task Force on Improving Fuel Efficiency of the Department of Defense Weapons Platforms.

- Richard Truly served as a member of: 1) Steering Committee for Earth Day 2000, 2) U.S. Naval Academy Board of Visitors, appointed by President Clinton; 3) Army Science Board, appointed by the Secretary of the Army, and 4) a Senior Advisory Group to Commander in Chief, U.S. Space Command.
- Richard Truly was invited speaker at the following forums during this performance period: Edison Electric Generation Committee Meeting, EPA Seminar - Sustainable Development Speakers Series, American Wind Energy Association (AWEA) annual meeting.
- Richard Truly addressed the annual meeting of the American Wind Energy Association.
- Stan Bull gave an invited presentation at the American Petroleum Institute meeting on Climate Change in Houston, TX, in December 1999.
- Stan Bull was a panel member on the DOE Bioenergy Visioning meeting in Washington, DC, in December 1999, and is a member of Panel I of the DOE Energy R&D Portfolio Analysis 2000 panel. He also continued to serve on the Energy Advisory Council for the University of Colorado at Denver and on the Colorado Institute for Fuels and High Altitude Engine Research Advisory Committee at the Colorado School of Mines.
- Stan Bull was selected by Undersecretary Moniz to serve on Panel I for the DOE Energy R&D Portfolio Analysis.
- Eldon Boes completed the development of the Portfolio Analysis Chapter of the FY01 DOE Energy Resources R&D Portfolio in support of Undersecretary Moniz.
- Gene Peterson gave a presentation on bioenergy at the Federal Advisory Committee Act National Agricultural Research, Extension, Education, and Economics Advisory Board Semiannual Board meeting in October 1999.
- Jon Pietruszkiewicz was invited to lead the organization of a renewable energy and energy efficiency session for the upcoming 2000 Intersociety Energy Conversion and Engineering Conference.
- Bobi Garrett has been invited to serve on the external advisory panel for the newly established Biomass Energy Conversion Facility established by the Iowa Energy Center.
- Cecile Warner was elected to the American Solar Energy Society Board of Directors.
- Satyen Deb and Alex Zunger are members of the Advisory Committee for the International Conference on Ternary and Multinary Compounds.
- Richard Blaugher was appointed to the program committee for the Applied Superconductivity Conference to be held on September 17-22, 2000, in Virginia Beach, VA. The Applied Superconductivity Conference sponsors the conference and IEEE publishes the proceedings. He was appointed to the DOE Steering Committee for developing the "Cryogenic Roadmap" for superconducting power devices.
- Technology manager, Kevin Craig, was elected to the Biomass Energy Research Association Board of Directors.
- Irene Hays serves on a National Academy of Science committee to write the technology education addendum to the National Science Education Standards; Washington, D.C. meeting in January.
- Helena Chum was requested to participate in bioenergy technology roadmapping.
- Lynnae Boyd served on National Merit Review panels for Inventions and Innovations and National Industrial Competitiveness through Energy, Environment, and Economies.

Internationally-Focused Leadership and Professional Activities

- Bob Meglen was chief opponent at Thesis in Umea University (Sweden). He was also a speaker at the Forest Products Symposium in Umea in October 1999.
- Technology manager, Cathy Gregoire Padro, was elected the Operating Agent for Annex 13 of the International Energy Agency Hydrogen Agreement and was also asked to serve as the U.S. representative to the International Gas Union for development of a report on the role of natural gas in hydrogen.
- The Japanese Science and Technology Agency asked NREL to provide input to their benchmark effort on bioenergy activities comparing Japan with U.S. and Europe and planning activities. A delegation visited

NREL and the Burlington, VT, gasifier to provide input on the future of their municipal waste management activities.

- The NREL Technology Cooperation Agreement Pilot Project (TCAPP) team participated in COP-5 and convened side events where countries presented their progress under TCAPP and convened meetings between Dan Reicher and other senior U.S. officials and senior developing country officials and business representatives to discuss effective approaches for implementation of technology transfer under the United Nations Framework Convention on Climate Change. Also, convened events to present air quality pollution health benefits of clean energy technologies based on results from work with Argentina, Chile, and Korea.
- The Deployment Facilitation organization led discussions with Brazil, Mexico, Egypt, India, and several southern African countries on the development of joint implementation and clean development mechanism projects.

Local/Regional Leadership and Professional Activities

- As a commitment to the Denver-area community and at the request of the Regis University Board of Trustees and Father Michael Sheeran (President of Regis), Director Truly is the Chair of the *Forum on the Future of Regis University*. The forum, consisting of nine task forces covering all aspects of Regis, includes over 200 national and Colorado leaders. The forum will report its findings and recommendations to Father Sheeran and the Regis Board of Trustees in the summer of 2000.
- Within the local community, NREL hosted an art contest for the design of the NREL holiday card, and the director presented the winning student with a $500 savings bond, provided by MRI/Battelle/Bechtel.
- NREL staff met with state officials from Colorado to educate Colorado officials on the potential benefit of energy efficiency and renewable energy technologies in meeting state goals, including improving air quality and Smart Growth.
- Irene Hays serves on the board and represents NREL on the founding Board of Directors of the Colorado Mathematics, Science, and Technology Education Coalition; meetings in November, December, and January. She serves on the board and represents NREL on the Industry Advisory Board of the Colorado MESA (Mathematics, Engineering, and Science Achievement); meetings in November, December, and January.
- Jerry Bellows, associate director for Laboratory Operations, serves on the Advisory Board for the Colorado State University Department of Mechanical Engineering.

Issues

None

Critical Outcome 3.0 Laboratory Viability

Ensure the long-term viability of NREL through enhancement of institutional visibility and ensuring retention and development of core scientific and business competencies and facility capabilities.

Performance Objective 3.1: *Build and sustain the core technical competencies of NREL (capabilities, facilities and equipment).*

Performance Indicators

3.1.1 Discretionary Investments are strategically targeted to build capabilities at the Laboratory.

3.1.2 Strategic hires are made in NREL research centers that move the Laboratory towards achieving technical objectives.

3.1.3 NREL's strategy provides a framework for facility and equipment budget requests.

Significant Performance Indicator Accomplishments

Capabilities Enhanced

- New facilities for the Biotech Center at the Field Test Laboratory Building (FTLB) were completed and brought on line this period. Capability additions include:
  - Consolidate and better integrate the center's laboratory space for metabolic, genetic, and protein engineering.
  - Expand capabilities to perform plant biotechnology.
  - Better align Laboratory resources in three centers to respond to growth in the bioenergy and bio-based products area.
- The new Solar Radiation Research Laboratory (SRRL) was completed and brought on line this period providing the following benefits and capability additions/enhancements:
  - For the first time in over 20 years, the team of specialists working on solar radiation measurement and instrument calibration are able to work together in a facility expressly designed for the research and development topics.
  - The laboratories in the new SRRL are: Metrology - for the calibration of measurement and test equipment; Optics - for the characterization of spectroradiometers and other instruments; Data Acquisition - for development and operation of renewable resource monitoring systems; and, Electronics - for the support of system development, operations and maintenance.
  - The Outdoor Instrument Platform provides NREL and DOE the capacity to be "the world's largest" radiometer calibration facility and solar radiation monitoring station. Specifically, we can simultaneously calibrate up to 150 radiometers. All calibrations are directly traceable to the World Radiometric Reference maintained by the World Meteorological Organization in Switzerland (another unique NREL capability for the DOE).
  - World-Class Radiometer Comparison Facility. The new SRRL provides the DOE with a facility designed specifically for the comparison of Absolute Cavity Radiometers. The largest such facility of all national laboratories, SRRL can host up to 30 participants for these outdoor comparisons, enough to represent all known interests in North America.
- NREL designed, procured, and implemented a small systems testing capability at the Outdoor Test Facility. This capability will be used to test a variety of small photovoltaic and wind systems typical of those used in developing countries. The data will be made available to U.S. industry, allowing improvements to be made in their products and to judge the performance of their competitor's products in the international arena.
- The analytical capabilities of the fluidized bed reformer system were upgraded for the Hydrogen Program.
- Proof-of-principle experiments on a near-infrared instrument probe for measuring mechanical properties of standing trees were completed. This $45K investment has led to $700K in follow-on funding from the DOE Office of Industrial Technologies and two collaborators to implement the concept.
- Our outcome of the Director's Discretionary Research and Development (DDRD) program is hiring new talent into the Laboratory. One example is the hiring of an expert in dye sensitized solar cells as a full time employee.

- NREL has utilized cutting-edge, Web-based tools to deliver measurement data to its customers in a more efficient and timely manner. NCPV collaborators are now able to view real-time scanning electron microscopy images from their samples remotely from their desktop via the Internet.
- Exploratory work on new small dish solar concentrator concept was conducted, which led to follow-on funding through the Concentrating Solar Power Program.

Strategic Hires

- Ten strategic hires are planned for FY00. Strategic hires are those that fill critical capability gaps bringing specialized skills and experience to NREL as required to meet mission responsibilities. During this four-month performance period, six of these were filled. Two examples of "strategic hires" are:
  - A senior engineer with 20 years of experience in the automotive industry having specialized skills in thermal sciences, fluid dynamics, battery management, and computer-aided engineering and design was hired into the Center for Transportation Technologies and Systems.
  - A senior scientist having unique skills in ultra-fast laser spectroscopy was hired into the Basic Sciences Center to complement the work of NREL's senior research fellow and to support DOE Office of Science projects.

Facility and Equipment Plans and Budgets

- NREL has developed a draft 20-year view of the Laboratory's vision that will provide the umbrella for the Site Development Plan and FY02 facility requests. In addition, a framework for considering capital investments was developed and presented at Summit V. The framework addresses: 1) sustaining the value of DOE Office of Energy Efficiency and Renewable Energy assets; 2) cost-effectively meeting requirements; or 3) addressing emerging needs. This framework is being used to evaluate and present the FY02 capital budget request. NREL's current 5-Year Plan (00-04) highlights key areas of growth and strategic development opportunities that provide the rationale for considering investments in the latter two areas. Current program requirements along with anticipated growth in photovoltaics, basic science, hydrogen, and bioenergy provide the basis for a science and technology addition to the Solar Energy Research Facility and modifications to the FTLB.

Other Significant Accomplishments and Contributions

- NREL participated in an initial General Accounting Office (GAO) site visit to gather information on our DDRD program. Information was collected and provided in response to GAO questions following the visit.

Issues

- Whether and in what form the GAO DDRD audit will occur is uncertain. NREL is prepared for the audit, but it could be time consuming if GAO wants to go back to 1992 because that will require a manual review of hard copy files.

Performance Objective 3.2: *Strengthen NREL's staff, leadership, and core business and mission support competencies.*

Performance Indicators

3.2.1 Complete planned revisions, initiated in FY99, to management practices that enhance staff development.

3.2.2 Leadership development programs are implemented that enhance the skills and abilities of current and future NREL leaders.

3.2.3 Implement the Improvement Program defined in FY99 to strengthen business and mission support competencies.

Significant Performance Indicator Accomplishments

Attracting, Developing, and Retaining Staff

- FY00 Affirmative Action Plan and FY00 Retention Plan were completed.
- NREL's FY00 Diversity Plan was developed and submitted to DOE GO.
- The management and supervisory skills training module of NREL's People Development Program/Executive Leadership Program was implemented during this performance period. This program was patterned after Bechtel's "People Development Program." NREL staff were trained and certified in Bechtel's program which forms the basis of NREL's program.
- The selection of Towers-Perrin was completed during this performance period in implementing the MRI-led employee Benefits Value Study. In addition, 30 companies were identified as those against which MRI/NREL will benchmark.
- NREL has developed and is now implementing an overall strategy for attracting and retaining key staff. Significant milestones reached this performance period include:
  - Innovative and aggressive total compensation strategy was developed and submitted for DOE approval. This strategy is built on four components: merit adjustment, equity adjustment, promotion pool, and variable funds compensation tools. Utilization of this strategy and set of tools will enable NREL to attract and retain high quality staff, as well as properly recognize and reward staff performance and development.
  - Salary market studies used by NREL to provide more robust data for decision making and enhancing NREL's competitiveness in attracting quality staff were revised and expanded.
- Strategic hires were designated by hiring managers so that special emphasis can be placed on getting these hires made to achieve the strategic mission objectives of NREL.
- All staff were scheduled for required training needed for their work assignments.
- The staff performance appraisal process designed in FY99 as part of its People Development Program was implemented. The new process aligns staff assignments and performance with the strategic objectives of programs and the Laboratory, and emphasizes career development and planning.
- NREL's retention-oriented programs and management activities were expanded and enhanced this performance period to include:
  - NREL's "Jumpstart Program" orientation for all new hires.
  - Exit interviews will be conducted with departing staff and information gathered will be shared with management as one basis for improvement.
  - Employee/supervisor intervention resources are now made available as needed to resolve issues in the workplace.
- NREL's Human Resources Management System was revised and enhanced to align with NREL's business and programmatic needs, including:
  - Seven policies were updated to reflect NREL's programs, questions, and business needs.
  - Thirteen Laboratory-level procedures were published on the Intranet.
  - Eighteen Laboratory-level procedures were drafted for implementation in FY00.

NREL Improvement Program

- NREL's improvement program, as developed in FY99, was implemented during this performance period. Specifically:
  - A senior program manager with extensive experience in developing and leading improvement efforts was hired in January to lead NREL's improvement program. He came from the U.S. Air Force Space Command where he designed, implemented and managed their successful improvement program. He is

also one of only 250 individuals certified by the Department of Defense in Business Process Reengineering.
- The program's budget and performance objectives were established through the establishment of an approved annual operating plan.
- Initial improvement projects are underway, specifically: HR employment and recruiting processes, and NREL's Integrated Planning and Assessment Management System development.

Issues

None

Performance Objective 3.3: *NREL's institutional strategy is strengthened and enables responsible stewardship of the Laboratory.*

Performance Indicators

3.3.1 External reviews indicate that NREL's strategies and plans reflect and address market, technology, and policy drivers and opportunities.

3.3.2 NREL's integrated planning, execution, and measurement systems support developing and implementing EERE's strategic management system.

Significant Performance Indicator Accomplishments

Institutional Strategy

- In addition to providing input to NREL's strategic plan, the NREL National Advisory Council (NAC) continues to identify strategic issues/opportunities that the Laboratory is assessing as part of setting the context for future plans. One example is understanding the role of storage in addressing the intermittent nature of renewable resources.
- The NREL NAC has taken a leadership role in the review and critique of NREL's Five-Year Plan FY00-04. The comments indicate that the Five-Year Plan addresses the relevant drivers and opportunities. Specific examples of reviewer's comments include:
  - "The [plan recognizes the importance of] natural gas as a complement to the renewable resources…thus its inclusion provides for distributed generation systems that can sustain services in the absence of [renewable] resources." (Dick Balzhiser)
  - "PV is recognized as an important option for which R&D must focus on increased efficiency at lower costs." (Dick Balzhiser)
  - "The strategic objective should be to achieve stated market penetrations with specified technologies over various time periods." (Mason Willrich)
- NREL prepared an updated Institutional Plan that provides a more comprehensive view of the Laboratory and its role in supporting DOE programs. DOE is reviewing this plan with comments due in mid-February.

Supporting DOE EE's Strategic Management System

- NREL reviewed and provided comments and suggestions to the DOE Office of Energy Efficiency and Renewable Energy (DOE EE) on several drafts of the DOE EE Strategic Plan and DOE EE Strategic Management System. This interaction ensured that NREL was aware of DOE EE's evolving strategic plan in a timely manner, and ensured that DOE EE was aware of NREL's needs for interaction with DOE EE's planning activities to maximize the effectiveness of planning in both organizations.
- NREL and DOE EE agreed on changes to be made to the FY03 Field Budget Call, including sharing planning guidance earlier in the planning cycle, eliminating Field Planning Proposals, and including a

capital planning summit. These actions will help to align the Laboratory's response with DOE EE priorities as well as eliminate the cost of non-value added activities.

- NREL and DOE EE agreed on the justification information needed for FY02 capital budget projects. This will provide DOE EE with a stronger information base to use in budget planning and budget defense.
- NREL prepared a list of high-level FY00 milestones against which NREL's programmatic performance will be assessed. These are currently under review at Headquarters.

Issues

None

Critical Outcome 4.0 Mission Support

Design, enhance, and implement NREL business and management systems and work processes to provide an effective and efficient work environment that enables execution of the mission.

Performance Objective 4.1: *Build, improve, and maintain appropriate enabling infrastructure that supports Laboratory objectives.*

Performance Indicators

4.1.1 NREL's Information Technology Architecture Initiative is completed per the NREL Information Technology three-year Strategic Architecture Plan.

4.1.2 Feedback from GO indicates that any issues arising from Y2K compliance are addressed appropriately.

4.1.3 All construction projects and related moves will be completed on time and on budget.

Significant Performance Indicator Accomplishments

Information Technology (IT) Infrastructure

- Information Technology Architecture Initiative (ITAI) projects are all on schedule and within budget for the first performance period for FY00. All scheduled tasks were completed and all milestones were met. Specific projects completed this performance period are:
  - Custom applications.
  - Desktop integration – Phase II.
  - Y2K activities administration (see Y2K section below).
- MRI continued to participate in the IT Steering Committee to provide initiative and project oversight, and resource allocation guidance.
- Data Systems Infrastructure projects are all on schedule enhancing NREL's computational capabilities, productivity, and cost efficiency:
  - NREL's use of the mainframe computer during this performance period was eliminated.
  - NREL converted to single topology (token-ring was eliminated).
  - Laboratory-wide high-speed network (10/100MB switched Ethernet) was implemented.
  - Migrated from Novell to Windows NT environment to provide greater functionality.
  - Wiring for 3,300 network and telephone connections was upgraded.
  - Implementation of Systems Management Server/Apple Network Assistant was completed.
  - Telecom switch completed and all tasks on schedule.
  - Netware to Windows NT migration completed.

Successfully Transitioned Y2K

- NREL is fully compliant and operational as we successfully transitioned to the year 2000. Proactive investment in and management of Y2K readiness enabled NREL to effectively meet all DOE compliance and reporting requirements as well as meet NREL's mission and business needs. We believe this activity to be successfully completed such that full acknowledgement of performance should be provided in this performance assessment, and the performance measure should be dropped for the remainder of the fiscal year.

New Facilities Support NREL Science

- All construction projects are managed for completion within budget and on schedule, with all interim milestones completed as planned. Move from Building 16 to the Field Test Laboratory Building was initiated and will be complete by the end of the second quarter.
- Construction of the Solar Radiation Research Laboratory (SRRL) was completed on schedule and within budget during this performance period, and moves from Building 16 and the Outdoor Test Facility to the SRRL are complete.

- NREL has worked proactively with DOE to identify and evaluate the impacts and options of space consolidation in Washington D.C.

Other Significant Accomplishments and Contributions

- Building 27 lease renewal was completed on schedule (November 99).

Issues

None

Performance Objective 4.2: *Demonstrate operational and business management effectiveness and efficiency supporting Laboratory objectives and DOE requirements.*

Performance Indicators

4.2.1 NREL performance metrics will demonstrate efficiency gains, and/or productivity enhancements.

4.2.2 NREL's foreign national program is effective in achieving both Laboratory needs and DOE expectations.

4.2.3 NREL will establish and maintain an effective travel management process and reduce travel costs.

4.2.4 NREL will establish a computer security program consistent with the risk at the Laboratory.

4.2.5 NREL will establish a baseline describing the work environment as the basis for future improvement.

Significant Performance Indicator Accomplishments

Improvements in Efficiency and Productivity

- An approximate 50% reduction in patent filing fees, at an estimated saving of $44K per year, was realized by taking advantage of an identified cost savings opportunity that allows NREL to file patent applications under MRI status as a small entity non-profit organization.
- Electronic open enrollment forms for employee benefits were used for the first time during this performance period reducing the cost and time requirements of this process.
- MRI proactively assisted NREL with the implementation of electronic recruiting tools that were used for the first time during this performance period. This enables NREL to reach a broader and more diverse audience in a timely manner to meet programmatic and business needs.
- Oracle "fixed asset" management module was implemented on schedule in October.
- New procedures were implemented for tracking and accounting for better property management and reporting.
- A custom accrual system for subcontracts and purchases was implemented this performance period. This system:
  - Provides for greater automation and more complete data.
  - Is completely integrated with the Oracle purchasing system.
- NREL successfully used its new systems for all IRS reporting this period, saving staff an estimated one to two weeks on vendor reporting (Form 1099).
- NREL is implementing its approved Make or Buy Plan with all tasks completed as scheduled this performance period. Full implementation will provide a structured process to make informed decisions about which administrative functions will be performed in-house or through subcontracts.
- NREL met its internal goals for this point in the fiscal year, putting us on track to meet year-end small/small disadvantaged/women-owned subcontracting goals of 60%/6%/5%, respectively.

Foreign National Program

- The following tasks were completed per NREL's implementation schedule of its Foreign National Program:
  - J-1 Visa Annual Report.
  - Implementation of a "tickler file system" for visa expiration.
  - International "Jumpstart Program" for foreign nationals (provides training to hosts).

Computer/Cyber Security Program

- NREL aggressively implemented a balanced program meeting the needs of DOE and the Laboratory. The following tasks were completed on schedule and as required to implement NREL's Computer Security Program:
  - Admiral Truly actively participated in activities of the DOE laboratory directors including a meeting with Secretary Richardson on cyber security issues and DOE/Laboratory relations to properly clarify and define requirements for Tier 3 laboratories.
  - Security banner deployment on NREL computers.
  - Development of NREL's Cyber Security Program Plan, and subsequent approval from the DOE Golden Field Office (DOE GO) on January 26.
  - Quick and effective response to all new virus threats as they emerged.
  - Quick and effective response to Web site defacements.

Other Significant Accomplishments and Contributions

- January 20 hearing before administrative law judge resulted in dismissal of a $500K claim for workers compensation benefits that was filed five years ago.
- Supported DOE GO to achieve successful audit of DOE GO's litigation oversight. NREL Legal Office received recognition for "active support of GO" Office of Chief Counsel.
- In-house legal capability was strengthened by expanding the number of attorneys with Colorado law licenses to three (on-roll attorney awarded Colorado license and new-hire attorney previously licensed in Colorado).
- FY00 cost proposal negotiations were completed and received DOE GO approval for indirect rates on November 22.
- New Director's Discretionary Research and Development Program financial tracking database was completed by consolidating 1992 through 1999 data from old and new financial systems.
- *Records Management Handbook* and *PIX Style Guide* were completed.
- NREL Government Printing Office jobs were up 37% while utilizing the same level of resources as in the last performance period to accomplish them.

Issues

None

Critical Outcome 5.0 Environment, Safety, and Health

Ensure that NREL protects the safety and health of the workforce and the community, and the environment.

Performance Objective 5.1: *Sustain excellence in safety and health, and environmental protection.*

Performance Indicators

5.1.1 NREL's ES&H performance, as measured by a composite score, meets the target negotiated with DOE.

5.1.2 NREL will complete the DOE Phase II on-site verification process, and address identified corrective actions.

Significant Performance Indicator Accomplishments

ES&H Performance

- NREL provided direct input to the Safety Management Implementation Team (SMIT) Performance Measures Working Group via the National Laboratory Improvement Council (NLIC). This involvement helps assure that NREL's ES&H composite indicator is consistent with and supportive of the set of complex-wide Integrated Safety Management (ISM) performance measures being established by the working group.

Phase II Verification

- The ISM Phase II verification was completed on an accelerated schedule resulting in a recommendation for approval from the DOE ISM Verification Team. In this compressed timeframe NREL prepared comprehensive documentation files, completed site-wide preparations and training, and provided extensive logistic support for the DOE team. Successfully completing this task well ahead of schedule assists the DOE Golden Field Office (DOE GO) in meeting new DOE deadlines for ISM implementation. This portion of the performance indicator is considered complete.
- An extremely high degree of coordination and cooperation was demonstrated by the Laboratory and DOE GO to complete the necessary preparations for the accelerated ISM Phase II verification. By establishing and maintaining a project plan that clearly defined key tasks and responsible parties the DOE GO/NREL team successfully completed in less than a month a workload that would have been aggressive for a three-month period. This cooperative effort further strengthened the working relationship between DOE GO and NREL, and helped assure the best possible implementation of ISM.
- A corrective action plan (CAP) was developed, submitted to DOE GO, and implemented for the two deficiencies identified by the DOE ISM Verification Team. Due to one of the deficiencies being related to quality assurance, the ISM CAP was closely coordinated with the existing Quality Assurance Program project plan. All necessary actions will be completed on an accelerated schedule to help assure that the May 22, 2000 implementation date prescribed by DOE GO is met.
- Director Truly and ES&H Office Director McConnell initiated unannounced walk-throughs of NREL facilities to inspect and observe safety, occupational health and environmental conditions, and discuss issues with staff, as an enhancement to our self-assessment process. The schedule calls for a walk-through of one facility per month. Thus far, all of Building 16 and the FTLB have been completed.

Other Significant Accomplishments and Contributions

- NREL, with participation from MRI, provided a timely and comprehensive evaluation of the impact on the Laboratory of moving under OSHA's jurisdiction.
- The Environmental Protection Agency (EPA) Region 8 federal facilities coordinator identified the NREL environmental management program as a model for use by other federal laboratory operations, and has invited NREL to participate in educational presentations conducted by EPA. The outcome of the informal review conducted by EPA and the invitation to disseminate lessons learned is a particularly strong endorsement of NREL's incorporation of the various environmental management elements into a single

coordinated program and the integration of the resultant program with Laboratory planning and management processes.

- NREL technology and deployment program achievements continue to demonstrate integration of ES&H issues:
  - NREL and Brookhaven National Laboratory sponsored a workshop on the use of lead-free solders in photovoltaic module manufacturing. The company that developed the technology, ASE Americas of Billerica, MA, shared their patents and technical details with photovoltaic industry participants at the workshop. The lead-free solder technology reduces environmental and health risks during the life cycle of the photovoltaic module, particularly at end-of-life landfill disposal, and assists compliance with EPA regulations.
  - NREL provided technical management and funding support for a document released by the National Wind Coordinating Committee entitled *Studying Wind Energy/Bird Interactions: A Guidance Document*. A nationally recognized team including wildlife biologists, statisticians, industry members, and environmentalists reviewed the document.
  - NREL completed studies of diesel exhaust particulate characteristics in the NASA Langley wind tunnel in support of diesel aerosol sampling methodology research. The results of these studies are being provided to diesel manufactures, as well as the EPA and the California Air Resources Board for use during rulemaking.
- A Laboratory-wide chemical inventory was completed during this performance period as part of the Chemical Management System (CMS) implementation. The inventory was completed with special initiative funding provided during the FY00 budgeting process, and was managed by existing ES&H Office staff as a special project. Completion of the inventory will allow effective implementation of the CMS to continue on schedule with inherent reduction of risks presented by hazardous materials on NREL sites.
- The Y2K Contingency and Continuity (C&C) Plan developed by a Laboratory-wide team led by the ES&H Office and Security and Emergency Services Team was successfully implemented for the millennium rollover. No incidents occurred that required C&C response and all monitoring and reporting requirements were met. Several elements of the C&C Plan will be retained as improvements to the NREL Emergency Preparedness Program.
- ES&H aspects of the Laboratory moves from Building 16 to the Field Test Laboratory Building and the Solar Radiation Research Laboratory were successfully managed, demonstrating a high level of coordination and integration by all participating organizations. Facility ES&H requirements, best-practice features, and user needs were identified and addressed through the design and construction process. Extensive preplanning and oversight was provided for the move and installation of large pieces of high-valued equipment and moderately large quantities of hazardous and/or temperature sensitive materials. New laboratories were placed in service in a timely manner and old laboratories were properly decommissioned through efficient application of required risk assessment processes. No significant issues or incidents were encountered due to the effective application of the NREL ISM System, and all move-related activities will be completed in February 2000.

Issues

- Due to the accelerated ISM implementation schedule and other unplanned resource commitments by both DOE GO and NREL, a target score for the ES&H composite indicator has not yet been negotiated. Renegotiation of this performance indicator is warranted given the point in the performance period (i.e., well into the second quarter) and possible impacts from the SMIT Performance Measures Working Group.

- DOE GO and NREL negotiated a mutually acceptable schedule for the DOE GO Surveillance Program consisting of one surveillance audit each month from January through September 2000. The schedule has already slipped one month, however, which will require extra resource commitments by NREL if the desired number of surveillance audits are to be completed by the end of the fiscal year. NREL strongly supports this activity due to its benefit to the Laboratory self-assessment process and will reassign resources as necessary to complete the surveillance audits.

Critical Outcome 6.0 Outreach and Communications

Provide leadership in building strong relationships and new alliances with local, regional, national and international stakeholders to advance awareness and support of the DOE renewable energy and energy efficiency mission and technologies, foster open communications, and advance math and science education.

Performance Objective 6.1: *Build relationships and new alliances that will increase awareness and support of renewable energy and energy efficiency technologies among stakeholders, and enhance the standing of NREL as a corporate citizen in its local and regional setting.*

Performance Indicators

6.1.1 Demonstrate the impact of implementing the NREL Stakeholder Strategy as evidenced by expanded and enhanced strategic alliances that support the DOE mission and DOE EE technologies.

6.1.2 The Colorado Executive Outreach program is established in FY00.

6.1.3 Demonstrate the impact of implementing the National Public Outreach Plan and NREL's continued commitment to a robust local outreach program through NREL's Visitor's Center.

Significant Performance Indicator Accomplishments

- Continued to align NREL's and DOE EE's stakeholder outreach activities by building the "Clean Energy for the 21st Century" campaign with DOE EE, producing a Web site, DOE EE corporate brochure, exhibit, poster, and post card. Creating and supporting this campaign helps ensure that DOE EE and NREL are jointly reaching out to our stakeholders with a coordinated message.
- Provided planning and technical expertise and support to diverse stakeholder groups including the Interstate Renewable Energy Council, Colorado Solar Energy Industries Association, and the International Energy Agency's Energy and Environmental Technology Information Centers.
- DOE's and NREL's visibility was greatly enhanced through implementation of NREL's National Public Outreach Plan which resulted in the following during this performance period:
  - CNN prime time story on NREL's work on renewable and energy efficiency technologies, including interviews with the Laboratory director and several researchers, aired on January 3.
  - *New York Times* interview with the National Center for Photovoltaics' John Thornton on "PV's Impact on the 21st Century" was conducted.
  - Laboratory visibility at the National Western Stock Show included a two week exhibition, three consumer workshops, and publicity in the *Denver Post.*
  - Editorial in *Global Power Engineering & Technology* "Projects in the 21st Century for Superconductivity Power Applications," was published.
  - Column by *Rocky Mountain News* reporter on the value of solar technologies was published.
  - *Washington Post* reporter Tom Kenworthy visited NREL for background information on the Laboratory in October.
  - *USA Weekend Magazine* article on "Green Power Network," based on an interview with Blair Swezey, was published.
- Strategic communications products were developed to support the NREL and DOE EE Earth Day 2000/Millenium campaign, including: the NREL Clean Energy for the 21st Century brochure.
- Identified and sent letters of invitation to the first nine candidates of the Colorado Executive Outreach (CEO) program. The identification process considered dozens of local companies that were then narrowed strategically to reach a cross section of industries. These invitees included the eSource, the Colorado Association of Commerce and Industry, the National Institute of Standards and Technology, the Land and Water Fund of the Rockies, Sierra Club, Colorado Office of Energy Management and Conservation, Richmond Homes, the Air Force Academy, and the University of Denver Environmental Institute.

Other Significant Accomplishments

- NREL received 28 external awards for technical communications, including four Distinguished First Place awards for the following publications: *Making the Most of Residential Photovoltaic Systems, Clean Energy for the 21st Century, Changing the Face of Energy,* and *Communities of the Future.*

- Four consumer workshops at the NREL Visitors Center were conducted and included more than 300 participants.
- The Colorado Renewable Energy Society "Solar Home Tour" was supported by NREL in October.
- The Community Leaders Reception at the Visitors Center, with about 80 civil and business leaders in attendance, was hosted by NREL and the DOE Golden Field Office.
- A Congressional Staff Study Tour January 13-14, including a tour and briefings, was conducted at the Laboratory for Karen Kimball (House Science Committee), John Mimikakis (Representative Boehlert's office), Cindy Trevithick (Senator Tancredo's office), Robert Gropp (Representative DeGette's office), and Curtis Yoakum (Senator Minge's office), as well as Acting Deputy Assistant Secretary, Bob Dixon and Nancy Jeffrey.
- NREL Charitable Giving Campaign for FY00 has shown considerable gains. Participation of NREL staff is up 10% and total funding has increased 26% over last year. MRI/Battelle/Bechtel partnership contribution of $10K was augmented by staff contributions for a total of $96K for FY00.
- NREL staff were asked to serve as editors of the following publications:
  - Angelo Mascarenhas served as editor for the Proceedings of the Materials Research Society Fall Meeting, and for the book *Ordering in Semiconductors*.
  - Robert McConnell served as co-editor for the Proceedings of the Electrochemical Society.
  - Art Nozik served as co-editor for *Photovoltaics and Photoelectrochemical Approaches in Photoconversion of Solar Energy*.
- Matt Knoedler (Representative Tancredo's office) was hosted at the Laboratory.
- Mr. Napolioni Masirewa, Fiji Ambassador to the United States, toured the Laboratory on November 5.
- Twenty-three national and local civil and business leaders were invited to participate on the board for the Colorado Energy Science Center Foundation.
- Several additional products were produced to support NREL and DOE EE stakeholders. These products include: expanding the capabilities of the Energy Efficiency and Renewable Energy Network (EREN) search engine by increasing the license to 150,000 documents; beginning a restructuring of the EREN site to add two levels of hierarchy; building a consumer information section on EREN; and, producing *Choices for a Brighter Future* a document that focuses on the potential of renewable energy in the different regions of the U.S.
- A new lobby exhibit was created for the NREL Executive Offices to enhance the visibility of NREL's mission and the importance of renewable energy and energy efficiency technologies. The Executive area of the Laboratory hosts VIP visitors to NREL; this is particularly important with the initiation this year of the Colorado Executive Outreach Program.

Issues

None

Performance Objective 6.2: *Implement programs that advance high quality science, mathematics and technology education.*

Performance Indicator

6.2.1 Results of evaluation tools and protocols developed by DOE-HQ for DOE National Laboratory Education programs indicate NREL education programs are effectively conducted and meet or exceed standards.

Significant Performance Indicator Accomplishments

- As a participant in a new DOE HQ collaboration with the National Science Foundation (NSF), NREL accomplished the following:
  - Gave a presentation at Argonne National Laboratory in November to DOE HQ and Laboratory education directors and National Science Foundation (NSF) leaders on the design of the evaluation process and the student development component of the new collaboration.
  - Participated with other national laboratory education directors in designing the collaborative internship program which is the core of this partnership.
  - Hosted an all day tour and planning meeting at NREL (January 20) for the points of contact for the participating universities assigned to NREL (i.e., Arizona State University, Mesa Community College, Colorado State University, Front Range Community College, Metropolitan State College of Denver).
  - Developed application materials and distribution list, and called for applicants from among experienced Colorado teachers to participate as master teachers for the undergraduate students preparing to be teachers who are participating in the DOE/NSF collaboration.
- As a participant in a new DOE HQ institute in biotechnology, environmental science, and computing technology which is conducted in partnership with the American Association of Community Colleges, NREL provided information to all the points of contact at the participating community colleges assigned to NREL by DOE, (i.e., Bismark State College, Community College of Denver, Dine Community College, Kilian Community College, Nebraska Indian Community College, Pueblo Community College) and began the applicant solicitation and planning process for the ten-week institute.
- The first meeting of NREL Education Advisory Council was conducted in November, bringing together members who represent the various NREL education stakeholders locally, regionally, and nationally from the precollege and university communities, the formal and informal education sectors, gender and ethnic underrepresented groups, and rural and urban populations. Tasks completed at this meeting include a review of:
  - NREL technical and human resources available for improving science and technology education.
  - The purpose, charter, and background of the Council.
  - The national regional, state, and local context for the Council.
  - The education recommendations of the Secretary of Energy's Advisory Board.
  - The role of the Colorado Energy Science Center in promoting support for high-quality education.
  - The strategic plan and recommendations for prioritizing the work to be done over the next year.

  Follow up has included a meeting in Washington D.C. with the chair of the Council, Dr. George Nelson, director, AAAS Project 2061.
- Candidates were recruited for the DOE Teacher Research Associates and the Energy Research Undergraduate Program to be conducted at NREL in summer 2000.
- The Coalition for Learning Opportunities and United Tutors program was augmented by developing a science/reading component and related hands-on science activities, which align to the Denver Public Schools reading and science standards and DOE education standards.
- In partnership with DOE GO, photovoltaic panels were distributed to Denver Public School teachers and related training for the teachers was conducted.

Issues

None